

South Carolina Department of Health  
and Environmental Control

# **Food Equipment Installation Manual**

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Bureau of Environmental Health  
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# Foreword

The purpose of this manual is to provide the food industry, equipment dealers, architects, engineers, consultants, regulatory personnel, and others with established sanitation criteria for the installation of equipment in retail food establishments. These criteria ensure that equipment installation will meet public health requirements and principles. It is intended to supplement Regulation 61-25, Retail Food Establishments, and to aid in the interpretation of food sanitation requirements. While all types of equipment and conditions are not covered, the fundamental concepts conveyed may be applied in all installations.

The submission of plans and specifications, including conferences, may be required by other regulatory agencies depending upon the type of facility being constructed or remodeled. See:

“South Carolina School Facilities Planning and Construction Guide” prepared by the Office of District Facilities Management, South Carolina Department of Education.

“Minimum Standards for Licensing in South Carolina Hospitals and Institutions’ General Infirmaries,” “Minimum Standards for Licensing in South Carolina Nursing Homes,” “Intermediate Care Facilities for the Mentally Retarded,” and “Community Residential Care Facilities” prepared by the Bureau of Health Facilities, South Carolina Department of Health and Environmental Control.

Contact with the State Fire Marshal is recommended, and in some situations, submittal of plans and specifications is required for approval.

The Southern Building Code, The Standard Plumbing Code, The National Fire Protection Association (NFPA) Bulletins, county codes, and municipal codes may be enforced by local officials, depending upon the location of the establishment. Prior contact with all regulatory agencies will prevent unnecessary delays and expense.

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# Chapter I - Plan Review Requirements

The submittal of plans and specifications is recommended for new establishments or remodeling of existing establishments to insure compliance with applicable requirements.

## **Review and approval of a set of plans and specifications by the plan review section requires:**

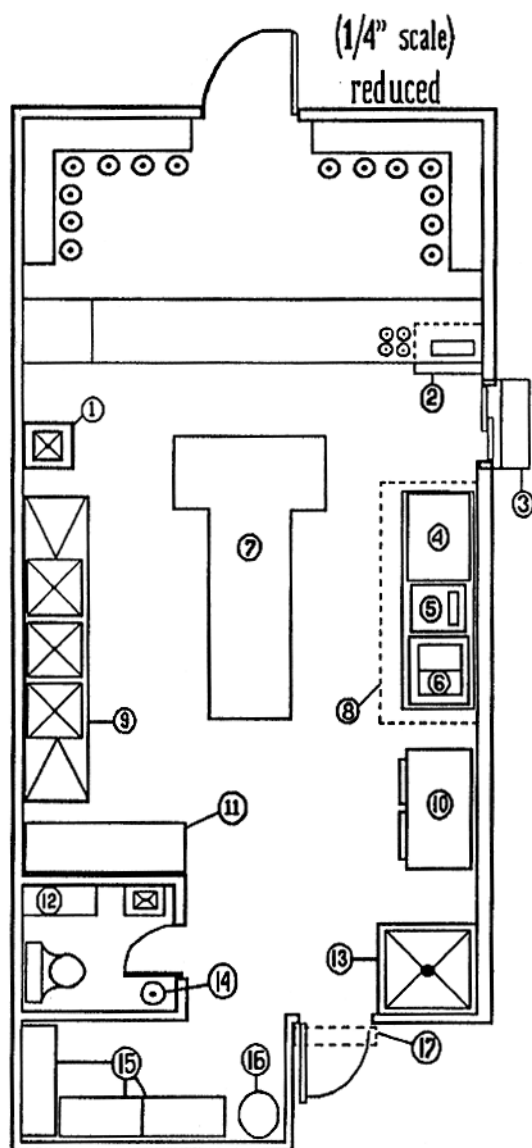
1. Name and complete address of person(s) to whom correspondence should be addressed.
2. Phone number, fax number & e-mail address (if available) of the contact person is requested should additional information be needed.
3. Name and complete address of establishment (provide physical location if different). **One complete set of plans and specifications** - submitted to the Plan Review Office. This set will be forwarded to the appropriate Food Supervisor upon approval.

**Include a plan-view scaled drawing** or a dimensional sketch to approximate scale (1/4-inch or larger).

Show the location of all food service equipment with each piece of equipment numbered to correspond with the equipment list.

(Figure 1 is a model layout with an accompanying equipment list and finish schedule which illustrates a procedure for submitting plans.)

4. **Include a copy of the menu.** Type and variety of foods will determine the type and variety of food preparation and service equipment needed.



## **Figure 1**

### **Typical Equipment List**

1. Hand lavatory with soap and towel dispenser.
2. Crystal Tips BR-100 Ice Maker with beverage dispenser on counter with indirect drainage.
3. Mars W-25 service window air door.
4. Star 156-36 electric griddle.
5. Star Sta-Rite 14HL food warmer.
6. Star Twin Pot 520-TE deep fryer.
7. Make-up table.
8. 10 ft. exhaust hood - NFPA 96 construction with make-up air exhaust fan - Jenn Air Model 241 NBTD  
supply fan - Jenn Air Model 241 RV
9. Three-compartment sink with two 24" drainboards.
10. Beverage-Air ER/EF-48 reach-in refrigerator with casters.
11. Metro Erecta 1860HC shelving.
12. Employee lockers.
13. Fiat TSB 500 mop service basin.
14. Covered waste container.
15. Metro Erecta dry storage shelving.
16. State Model SS8-66-1ART electric water heater.
17. Mars NHV-48 service entry air door.

### **Finish Schedule**

ACT = Acoustical Ceiling Tile

gyp. bd. = gypsum board (sheetrock)

	<u>Floors</u>	<u>Walls</u>	<u>Ceilings</u>
KITCHEN	vinyl tile	Marlite	ACT
DINING	vinyl tile	brick	ACT
TOILET	vinyl tile	Marlite	gyp. bd.

MENU: Submit a copy of the proposed menu.

*Note:*

Any equipment manufacturers and model numbers shown are used for illustrative purposes only.

5. Schedules and drawings to be included:
  - a. **Equipment** - include manufacturer and model number for each piece of food equipment.
  - b. **Finishes** - include all floor, wall, ceiling, and coved juncture base materials and finishes for each room or area. The dining area may be omitted.

Examples of acceptable materials/finishes are:

- (1) **Floors:** sealed concrete, vinyl tile, ceramic tile, epoxy resin, terazzo, etc. Vinyl tile floor coverings are not recommended under warewashers.
  - (2) **Walls:** sheetrock with washable paint, laminated plastics such as Marlite and Formica, fiberglass reinforced polyester (FRP) panels, concrete block with full strength block filler and washable paint, ceramic tile, etc.
  - (3) **Ceilings:** sheetrock with washable paint, laminated plastics, suspended acoustical tile products, etc.
- c. **Ventilation** - include manufacturer and model number, size, and location of each exhaust hood, fan, make-up air unit and rest room exhaust fan. Also provide complete data, to include lighting, filters, duct sizes, and fan capacities at specified static pressures.
  - d. **Plumbing** - include the locations of floor drains, floor sinks, and water supply lines. Ensure that plumbing will be installed according to the Standard Plumbing Code.



*Note:*

Contact public sewer authorities for grease trap requirements on public sewer systems. For onsite wastewater treatment (septic tanks), contact the environmental health section of the local health department for design and construction criteria for septic tanks and grease traps. For private water systems (wells), including existing systems, contact the local Environmental Quality Control (EQC) office for approval.

- e. **Lighting** - ensure that a minimum of 20 foot-candles of light will be provided on all working surfaces in food preparation areas, meat cutting rooms, equipment and utensil washing areas, at handwashing lavatories, and in toilet rooms. Provide at least 10 foot-candles of light, measured at 30 inches above the floor, in walk-in coolers and freezers, dry storage areas, and in all other areas, including dining rooms during cleaning operations. A written statement ensuring that this amount of light will be provided is acceptable. Light bulbs in food preparation areas, equipment and utensil washing areas, and food and equipment storage areas shall be shielded or shatter-resistant.
  - f. **Shop Drawings** - include all drawings and specifications of fabricated equipment such as exhaust hood systems, serving lines, salad bars, dish tables, etc.
- 6. State the source of water and method of sewage disposal.
  - 7. Provide the manufacturer and model number of the water heater(s). Water heater size should reflect storage capacity and recovery rate per hour at a 100°F. (37.8°C.) rise. The warewasher's hot water consumption will be based on 70% of the machine's total gallons per hour final rinse water usage at 20 pounds per square inch (psi). (See Chapter IX for hot water guidelines and refer to the warewasher's specifications for final rinse water usage.)

8. Provide the manufacturers and model numbers of all warewashing machines. All warewashing machines shall be approved by the National Sanitation Foundation (NSF), or shall otherwise comply with the requirements of Regulation 61-25, Retail Food Establishments. Domestic dishwashing machines do not comply with these requirements and are not approved. A warewasher without a built-in prewash section shall have a manual prerinse sink; except that, under certain use conditions, small warewashers and glass washers that do not involve the removal of gross food particles are exempt from prerinse requirements. Detergents and sanitizers shall be automatically dispensed, and dispensers shall be properly installed and maintained. Drying agents shall be injected downstream of the final rinse vacuum breaker.
9. All doors opening to the outside and service windows shall be equipped with self-closers or approved air curtains. Toilet room doors, except those opening to the exterior of the establishment, shall be equipped with self-closers.
10. Back-siphonage protection shall be provided for all applicable equipment such as disposals, warewashers, scrapping troughs, etc. when submerged water inlets are present. Potential cross connections, such as those created by hose connections, shall also be protected.
11. Utensils and equipment that are manually sanitized shall be sanitized in a utensil sink by either 170°F. (76.7°C.) hot water or an approved chemical. Specify in the plans which method will be used.
12. A recirculating pump and necessary controls, or self-regulating heat tape, shall be installed on a warewasher booster heater's 140°F. (60°C.) incoming water line if the water heater is located more than 25 pipe feet from the booster heater. This protects against cooling of the water in the supply line and ensures that when the booster heater requires 140°F. (60°C.) water, it is provided.

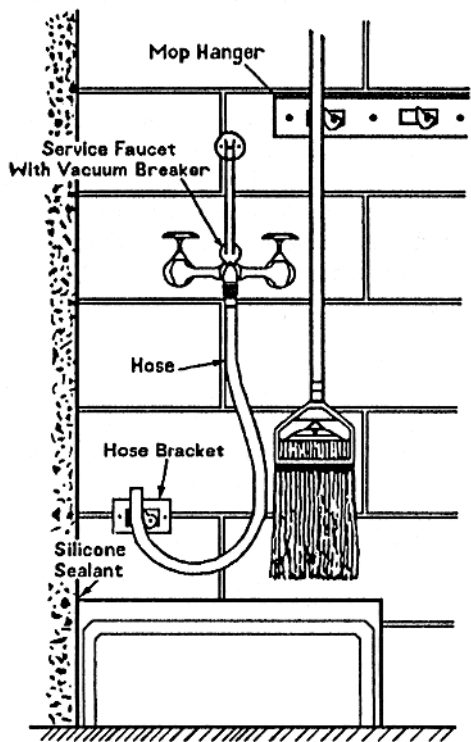
13. All warewashers utilizing hot water sanitization shall be equipped with the following:
  - a. A pressure regulating valve set at 15-25 psi flow pressure on the booster heater's 140°F. (60°C.) water supply line.
  - b. A pressure-temperature gauge on the 140°F. (60°C.) water supply line downstream of the pressure regulating valve.
  - c. A gauge cock properly installed immediately upstream of the final rinse spray heads. (See Chapter XI.)
14. Each handwashing lavatory shall be supplied with hot and cold water through a mixing faucet, and equipped with soap and sanitary towels. Self-closing, slow-closing, or metered faucets shall supply at least 15 seconds of uninterrupted water flow.
15. Equipment shall be installed using the following methods:
  - a. Counter-mounted equipment shall be on 4-inch sanitary legs, sealed to the counter, or portable.
  - b. Floor-mounted equipment that is not easily movable shall be on 6-inch sanitary legs, on casters, or sealed to the floor.
  - c. Equipment not on casters or otherwise not easily moved shall be sealed to the wall and/or adjoining equipment or spaced to facilitate cleaning.

\*\*\*This criteria shall be applied to permit all exposed areas of equipment and adjacent surfaces to be accessible for cleaning. If an item of equipment is not portable, is not installed on casters, or is not otherwise easily moved, it shall be (1) sealed to adjoining surfaces with an approved sealant or metal flashing, or (2) provided with sufficient space between and behind the equipment to allow easy access.

16. All shelving shall be a minimum of six inches above the floor or enclosed. All wooden shelving shall be painted or sealed to render a smooth, nonabsorbent, and washable surface.
17. Walk-in coolers/freezers shall be equipped with the following:
  - a. A minimum of 10 foot-candles of light is required in all areas measured at 30 inches above the floor. If meat processing or food preparation activities are conducted in walk-in units, 20 foot-candles of light are required on all work surfaces. Additional lighting is commonly required in prefabricated walk-in units. Light bulbs in walk-in coolers/freezers shall be shielded or shatter-resistant.
  - b. Floors shall be constructed of smooth, durable materials such as sealed concrete, quarry tile, metal, etc. Walls and ceilings shall be constructed of smooth, nonabsorbent, and easily cleanable materials such as stainless steel, aluminum, fiberglass panels, wood, etc.
18. An approved sink supplied with hot and cold water is required for the routine preparation of raw fruits and raw vegetables. Adequate drainboard space should be provided for vegetable preparation.
19. Three compartment utensil sinks shall have compartments large enough to immerse at least two-thirds of the largest piece of equipment or utensil to be cleaned. Drainboards shall be adequate in size to accommodate soiled utensils prior to washing and allow for proper air-drying of clean utensils. Overshelves, mobile dish carts, and pot racks may provide additional storage space for air-drying utensils.
20. At least one service sink or curbed mop basin supplied with hot and cold water shall be provided for the cleaning of garbage and refuse containers, mops, and for the disposal of mop water. While exterior construction of a can wash is acceptable, an interior location for this fixture has proven more convenient

and avoids problems with vandalism, freeze damage, and poor cleaning and maintenance. The floor in a can wash or mop basin shall be smooth, nonabsorbent, and easily cleanable. The walls around these facilities shall be smooth, easily cleanable, and washable to the highest level of splash.

(Figure 2 illustrates a recommended mop basin installation.)



**Figure 2**

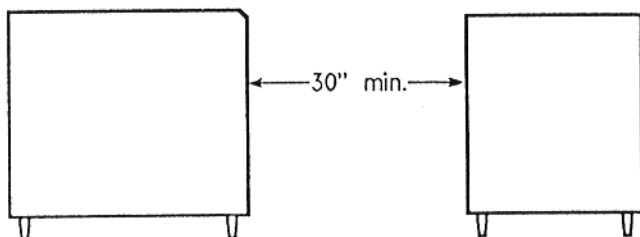
## **Chapter II - Planning**

Many architects, food service consultants, food equipment dealers, and related specialists provide guidance and service in the preparation of plans and specifications for review by the health authority. Major considerations in planning should include the following:

1. Private water systems, wastewater systems, and grease traps, including existing systems, shall be approved by the local health authority. Public wastewater authorities should be contacted for grease trap requirements on public systems. This is the first step in planning and should precede all other considerations.
2. Plan for an orderly flow of food from the point of delivery to storage areas, and to preparation and serving areas. There should also be a smooth flow of dirty kitchenware and tableware to and from the warewashing area. The flow of food, as well as utensils, should take into consideration those measures and precautions necessary to prevent contamination.
3. Walk-in coolers and freezers, and dry storage areas, should be located near the delivery entrance to avoid unnecessary traffic through work stations.
4. Refrigeration and frozen food storage facilities should be sufficient to properly store perishable food. Adequate facilities for hot food storage shall be provided.
5. Adequate dry storage space should be provided for bulk storage of paper goods, canned food, and other supplies. Frequency of deliveries should be a factor in space allocation. Adequate space should also be provided for the proper storage of utensils and equipment.
6. Equipment should be located where it is handy. For example, a reach-in cooler located beside a fry grill, or a French-fry freezer beside a deep fryer.

7. Allow for sufficient aisle space between equipment installations. A single aisle should provide a minimum of 30 inches for an employee to work. A minimum of 60 inches is needed for two employees working back-to-back and passing in a common area.

(Figure 3 illustrates recommended single aisle spaces.)



**Figure 3**

8. Equipment shall be installed to allow all exposed surfaces of the equipment and adjacent surfaces to be accessible for cleaning.
9. Food equipment which has been evaluated and approved for cleanability, durability, toxicity, safety, etc. by the National Sanitation Foundation (NSF), ETL Testing Laboratories, or Underwriters Laboratories (UL) is recommended.
10. Determine menus before equipment installation plans are completed. The food being prepared and served will determine the type of food preparation and serving equipment needed.
11. Plan for adequate and conveniently located handwashing lavatories in all food preparation areas, utensil washing areas, and in toilet rooms.

12. The size of the hot water system is based upon fixture demand for hot water consumption, and must include storage and recovery capabilities. (See Chapter IX.)
13. Plans must include lockers, coat racks, shelves, or other approved facilities for the orderly storage of employees' personal belongings and clothing.
14. Planning must include provisions for insect and rodent control, such as self-closing doors, screened windows, fly fans, insect electrocutors, fly traps, and location of garbage receptacles.
15. Most cooking equipment will require effective exhaust systems with make-up air. The local fire official should be contacted regarding fire safety requirements.
16. Construction design should facilitate sanitary cleaning and maintenance of the establishment and should include adequate lighting, easily cleanable finishes, and elimination of exposed studs, joists, rafters, and utility lines.
17. Plans should include complete drawings and specifications, elevations and cross-sections, equipment list by manufacturer and model number, and methods of equipment installation.
18. When an existing building is to be used for a retail food establishment, the local health authority should be contacted for an on-site evaluation of the facility and any used equipment.



## **Chapter III - Backflow and Back-siphonage**

Regulation 61-25, Retail Food Establishments requires protection of the water supply from backflow and back- siphonage. In addition to air gaps, backflow preventers may be used in retail food establishments to provide this protection. Backflow preventers are designed to protect the potable water supply from non-potable water sources.

Atmospheric vacuum breakers are frequently used with solenoid valves which control intermittent water flow requirements of food equipment. They are also used when connections are made to food equipment which contain submerged inlets (such as warewashers, disposals, soap dispensers, etc.), where hoses are used in the mixing or dispensing of pesticides and other chemicals, or where hoses may come in contact with other non-potable water sources (such as wastewater from washing garbage cans). These vacuum breakers are not designed for constant pressure and can malfunction if subjected to long periods of continuous pressure. Some examples of these devices that are commonly used are:

1. Watts No. 8 and No. 8A (single check valve with atmospheric vacuum breaker vent)
2. T & S B-968 and Watts No. 288A (single float and disc with large atmospheric port)

*Note:*

Similar devices provided by other manufacturers are also acceptable. Pressure vacuum breakers are also acceptable in some applications, such as hose reel installations.

Exposed in-line continuous pressure double check backflow preventers are used on water supply lines to hose reels, waste pulpers, power clean-up equipment, and hose connections where hose nozzles or other cut-off valves are located downstream of the device. They are designed to operate under constant pressure. Some examples of these devices that are commonly used are:

1. Conbraco No. 40-300 and Watts No. 7 (dual check valve backflow preventers)
2. Watts No. 9D (double check valves with intermediate vacuum breaker and relief vent)

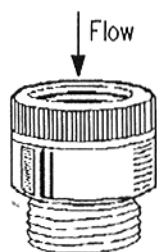
*Note:*

Similar devices provided by other manufacturers are also acceptable. Pressure vacuum breakers are also acceptable in some applications, such as hose reel installations.

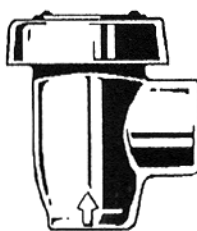
The most common plumbing violation recorded in retail food establishments involves hoses that are attached to hose bibbs equipped with atmospheric vacuum breakers. These hoses are often left under constant pressure with the pistol-grip nozzle or twist nozzle used as the cut-off valve. When this is encountered, one of the following options shall be exercised by the establishment to correct this violation:

1. An approved exposed in-line continuous pressure backflow preventer can be installed on applicable hot and cold water lines in lieu of the atmospheric vacuum breaker.
2. The nozzle can be removed from the hose so that the atmospheric vacuum breaker cannot be left under pressure.
3. The hose equipped with a nozzle can be turned off at the faucet and the hose drained after each use.

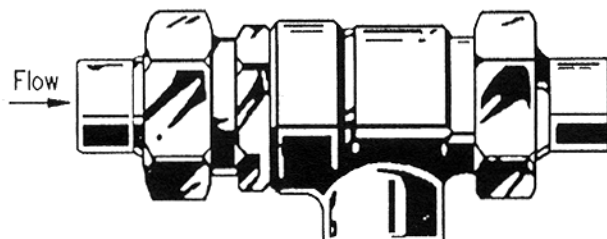
(Figure 4 shows some of these backflow preventers.)



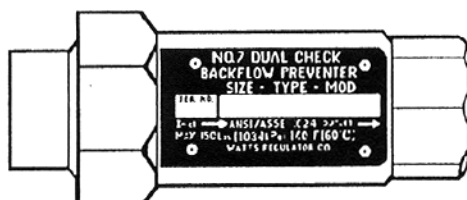
Watts No. 8A



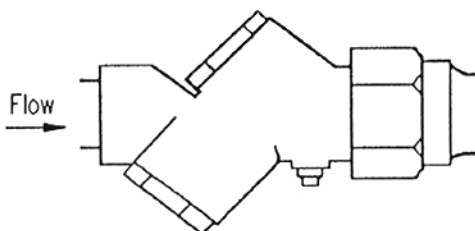
Watts No. 288A



Watts No. 9D



Watts No. 7



Conbraco No. 40-300

**Figure 4**

## **Chapter IV - Finishes**

Floors and floor coverings, wall finishes, and ceiling materials shall meet all requirements of Regulation 61-25, Retail Food Establishments; however, some construction materials require special considerations.

### **Floors**

Exposed concrete floors shall be effectively sealed to render a nonabsorbent surface. While monolithic floors, such as sealed concrete, terrazzo, and quarry tile, are recommended in warewashing machine areas due to proven durability, other materials, such as sheet vinyl and wooden floors coated with urethane products, are acceptable if maintained in good repair. Floors constructed with expansion joints, trench drains, utility stub-ups, and other installations which effect floor cleanability shall be trowelled smooth and sealed.

### **Walls**

Brick and concrete block walls in food preparation areas, utensil washing areas, equipment washing areas, toilet rooms, handwashing areas, and in garbage storage rooms shall have smooth, nonabsorbent, and easily cleanable surfaces that are washable to the highest level of splash or spray. Walls constructed of masonry products shall be trowelled, skim coated, or receive sufficient coats of full strength block filler to render a smooth surface prior to application of a washable paint. The degree of smoothness desired on the filled block should be thought of as “smooth as sheetrock.” It is recommended that the local health authority be contacted to inspect the quality of this work prior to application of the paint to avoid any misunderstanding of the cleanability standards relative to this treatment.

Wall materials such as fiberglass reinforced polyester (FRP) panels and plastic laminated panel products shall be installed using appropriate molding or other means of providing smooth, easily cleanable junctures. Paneling is permitted in food preparation areas, utensil washing areas, equipment washing areas, handwashing areas, and toilet rooms when used above wainscot height or above the highest level of splash or spray.

The level of splash or spray is usually thought to be about four to five feet above the finished floor. However, in some cases, such as installations of large pieces of equipment or warewashing machines, or around mixers, the level of splash or spray may be as high as eight feet above the finished floor.

Rooms used only for the storage of unopened packages or containers are exempt from these requirements.

### **Ceilings**

Permanent ceiling materials, such as gypsum board, plywood, and sheetrock, shall be smooth, nonabsorbent, and easily cleanable in food preparation areas, walk-in refrigeration units, equipment washing areas, and utensil washing areas. Suspended ceilings, in all areas, which are installed with lay-in replaceable products such as acoustical tile, are acceptable, provided the lay-in products are kept clean and in good repair. Ceilings of food storage rooms, toilet rooms, dressing rooms, and bar areas that are not constructed of suspended, lay-in ceiling panels, shall be sealed or painted.

Rooms used for the storage of unopened packages or containers are exempt from this requirement.

## **Chapter V - Fundamentals of Food Service Equipment Design**

Equipment which comes in contact with food or is subject to splashing with food debris shall be made of materials that are corrosion resistant, smooth, and nonabsorbent. Construction and design should permit all parts which require cleaning to be easily cleaned without the use of tools for disassembling, and should minimize places which can harbor vermin. Display equipment shall be designed to protect food from contamination by customers.

Equipment designed for the storage, display, and service of potentially hazardous food shall be capable of keeping such food hot or cold. Mechanical devices, such as warewashing machines, shall have been tested and approved for meeting nationally accepted cleanability and bacteriological standards, or shall otherwise meet all applicable requirements of Regulation 61-25, Retail Food Establishments.

Exhaust ventilation systems shall be maintained and operated to keep all areas of the establishment reasonably free of excessive heat, steam, condensation, vapors, smoke, and fumes. Effective air recovery (forced make-up air systems) shall be provided as necessary for exhaust ventilation systems.

## **Chapter VI - Food Equipment Installation Requirements**

Food equipment shall be installed as follows:

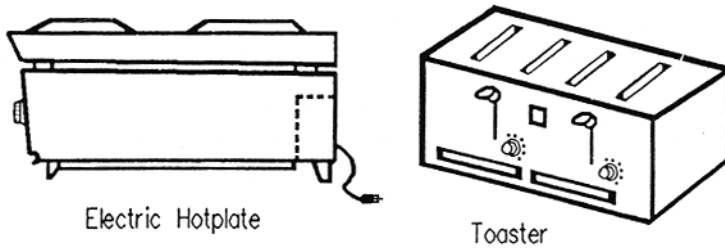
1. Counter-mounted equipment shall be on 4-inch sanitary legs, sealed to the counter or portable.
2. Floor-mounted equipment shall be on 6-inch sanitary legs, on casters, or sealed to the floor.
3. Equipment not on casters or not portable shall be sealed to the wall and/or adjoining equipment, or spaced to facilitate cleaning.
4. Portable equipment and equipment installed on casters shall be installed with flexible utility lines and/or quick-disconnect couplings.

The above criteria shall be applied to permit all exposed areas of equipment and adjacent surfaces to be accessible for cleaning. If an item of equipment is not portable, is not installed on casters, or is not otherwise easily moved, it shall be (1) sealed to adjoining surfaces with an approved sealant or metal flashing, or (2) provided with sufficient space between and behind the equipment to allow easy access.

### **Portable Equipment**

Food equipment that is small and light enough to be easily moved by one person shall be considered portable and shall be exempt from equipment installation requirements.

(Figure 5 illustrates some examples of portable equipment. The hot plate and toaster are both equipped with an electrical connection that can be disconnected.)



**Figure 5**

### **Counter and Undercounter Installation of Equipment**

Food equipment which is not readily movable because of size, weight, or rigid utility connections shall be installed on counters or tables as follows:

1. On 4-inch sanitary legs; or
2. Sealed to the counter; or
3. Properly spaced to facilitate cleaning; or
4. Equipped with an integral lift lever, pivoting foot, polyethylene wear strips, or a similar device which allows easy access under and around the equipment for cleaning.

Undercounter equipment installed on the floor shall be equipped with casters, sanitary skids, 6-inch sanitary legs, sealed to adjacent surfaces, or properly spaced to facilitate cleaning.



## **Casters**

Casters shall be of sanitary design, shall be properly sized for the equipment served, and should be compatible with the cleaning materials used. It is strongly recommended that equipment be installed on casters when possible. Equipment installed on casters allows easy movement and facilitates the cleaning of surrounding surfaces and equipment. Casters also allow for maximum utilization of space by reducing or eliminating space requirements for cleaning.

Casters can be installed on most food equipment, including ice machines and deck ovens. Flexible or quick-disconnect couplings will be needed on caster-mounted equipment with utility connections. Due to safety concerns, some tilting braising pans, equipment receiving direct steam lines, and some top-heavy equipment cannot be installed on casters. As this equipment cannot be installed on casters, adequate space must be provided around it to allow access for cleaning. Also, casters may not be the preferred option when floors are severely graded.

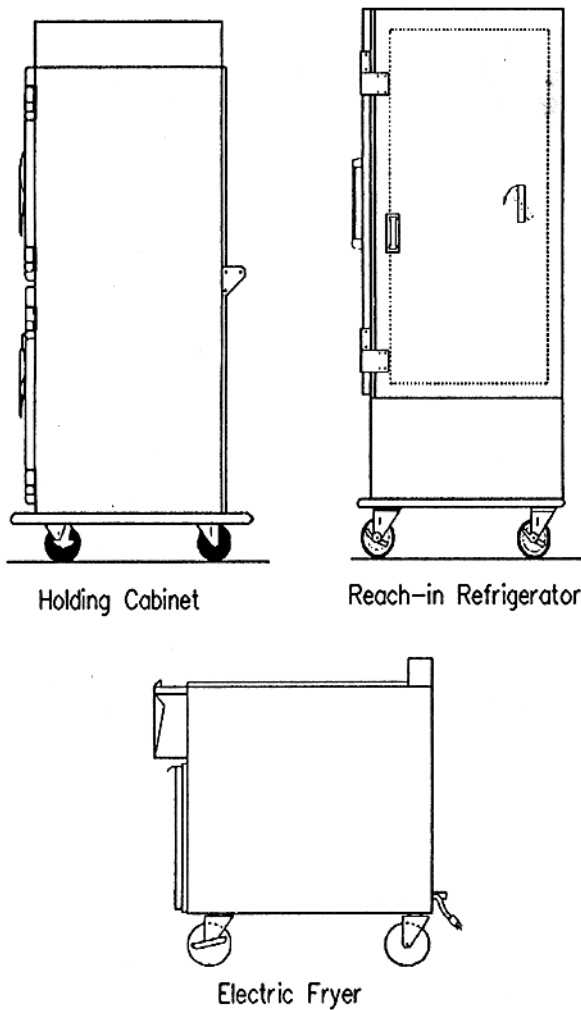
(Figure 6 illustrates equipment on casters.)

## **Sanitary Legs**

When equipment is supported on legs and installed on the floor, the legs shall:

1. Provide at least six inches of unobstructed space between the equipment and the floor.
2. Be of a design that is easily cleanable and constructed of approved materials. (Angle iron, bricks, and concrete blocks are examples of unapproved materials.)

3. Be arranged and built to prevent internal harborage of vermin or accumulation of liquids and debris.

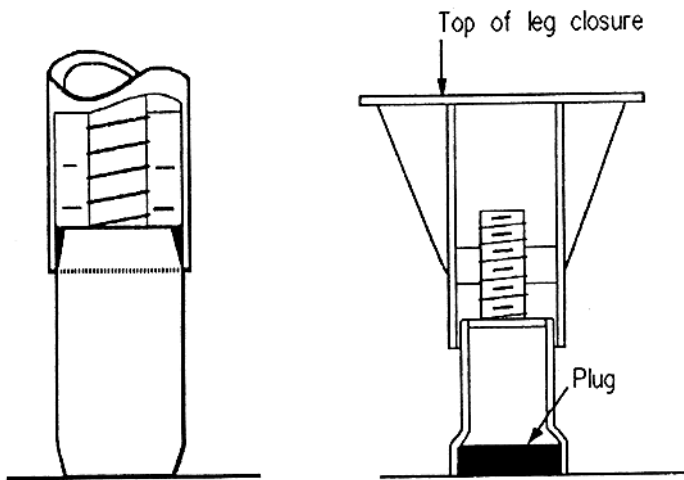


**Figure 6**

4. Provide a minimum of interference with cleaning at the leg-floor contact.
5. Contain no exposed threads, embellishments, or overhanging edges that serve as places for accumulation of dust, dirt, and debris.

For leveling food equipment without improvised shimming, it is desirable for the legs to be adjustable.

(Figure 7 illustrates sanitary leg construction.)



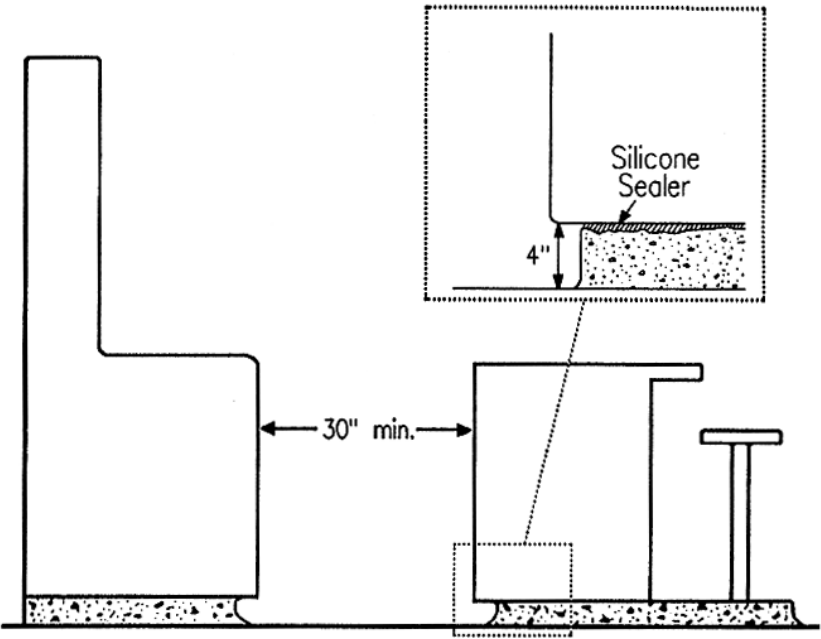
**Figure 7**

### **Masonry Islands**

Island installations of equipment reduce the total floor area that must be cleaned. Masonry islands should be a minimum height of four inches with a cove of at least 3-inch radius at the juncture of the island and the floor. The equipment should overhang the base at least two inches, but not more than the height of the island. The edges of the equipment should overhang the island to prevent

grease or other liquids which may spill over or run down the sides from running underneath. The juncture between the base of the equipment and the island shall be sealed to prevent vermin harborage. Remember to plan for a minimum of 30 inches for a single aisle and 60 inches for a double aisle.

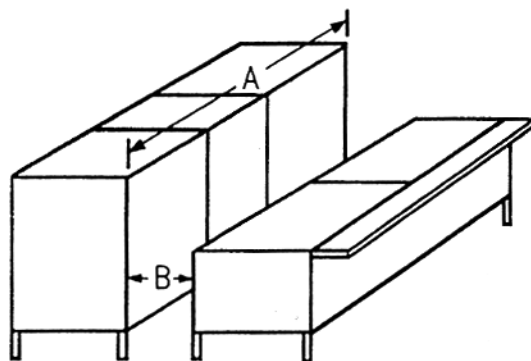
(Figure 8 illustrates a single aisle masonry island installation.)



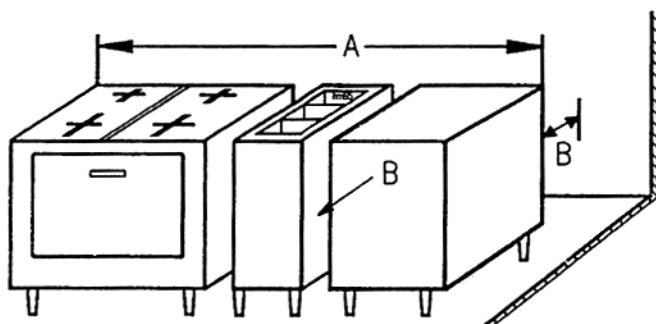
**Figure 8**

## **Spacing Requirements for Food Equipment**

Equipment not readily movable or sealed to adjacent surfaces shall be spaced to allow access for cleaning. The amount of space required between and behind equipment depends on the size of the equipment and the accessibility needed for cleaning the equipment and adjacent surfaces. Minimum space requirements for food equipment installation are as follows:



Equipment sealed together



Equipment spaced apart

1. Provided access is available from both ends of the equipment and the total equipment length is four feet or less (A), the equipment shall be spaced at least six inches from walls and other equipment (B).

2. Provided access is available from both ends of the equipment and the total equipment length is over four feet but less than eight feet (A), the equipment shall be spaced at least 12 inches from walls and other equipment (B).
3. When the total equipment length is eight feet or more (A), the equipment shall be spaced at least 18 inches from walls and other equipment (B).
4. A minimum of six inches of space shall be provided between items of equipment to allow access for cleaning. Additional space may be required for large equipment when six inches is not adequate to provide access.
5. Obstruction of the access opening between and/or behind equipment by a chase or rigid utility connection may require additional spacing.
6. Provide at least 12” of free space on either side of a handwashing lavatory when food, clean utensils/equipment, working surfaces, or other possible contamination concerns exist; otherwise, approved splashguards are required.

### **Floor Attachment of Equipment**

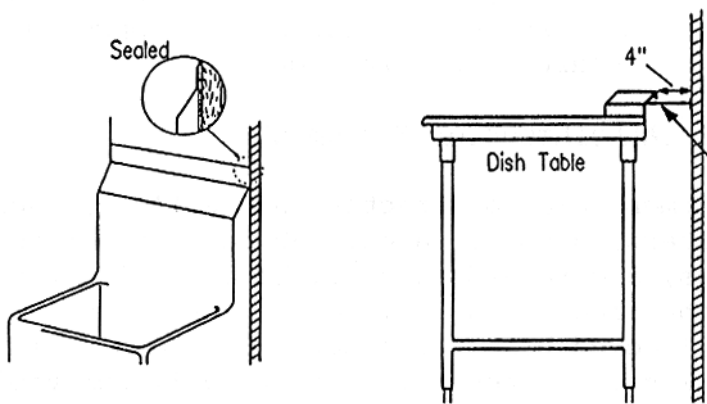
Equipment placed directly on the floor, such as counters, display cases, cabinets, proofers, ovens, and retarders shall be effectively sealed to the floor using silicone, metal flashing, vinyl coved base, or other approved material. Metal kick plates which are readily removable will not be required to be sealed to the floor, provided the base of the equipment is sealed to the floor or the areas behind the kick plates are easily cleanable.

## **Wall Attachment of Equipment**

Equipment attached to walls, such as lavatories, preparation sinks, utensil washing sinks, dish tables, counters, and cabinets shall be effectively sealed to the wall to prevent splash, debris accumulation, and vermin harborage. *Note:* any combination of bolts, screws, rivets, silicone sealers, or flashing that effectively closes the opening between the equipment and the walls in a smooth and sanitary manner will be acceptable.

If the equipment is open underneath, such as a drainboard, dish table, or open base table, it may be installed at least four inches away from the wall. This provision is made due to the fact that dish tables, drainboards, and immobile open base tables are accessible underneath the counter top and a space of four inches from the wall to the equipment is enough to facilitate cleaning.

(Figure 9 illustrates both of these installations.)



**Figure 9**

In cases where the space between the equipment and the wall is too large for use of a silicone sealant, metal or other approved flashing will be necessary for an effective seal. Examples of equipment that frequently require metal flashing are walk-in coolers and freezers, retarders, proofers, and large ovens. Some installations may require a combination of flashing and silicone sealant.

Equipment mounted on legs and placed against walls and which can be readily moved for cleaning will not be required to be sealed to adjacent surfaces (i.e. work tables and some equipment tables).

### **Exposed Utility Lines**

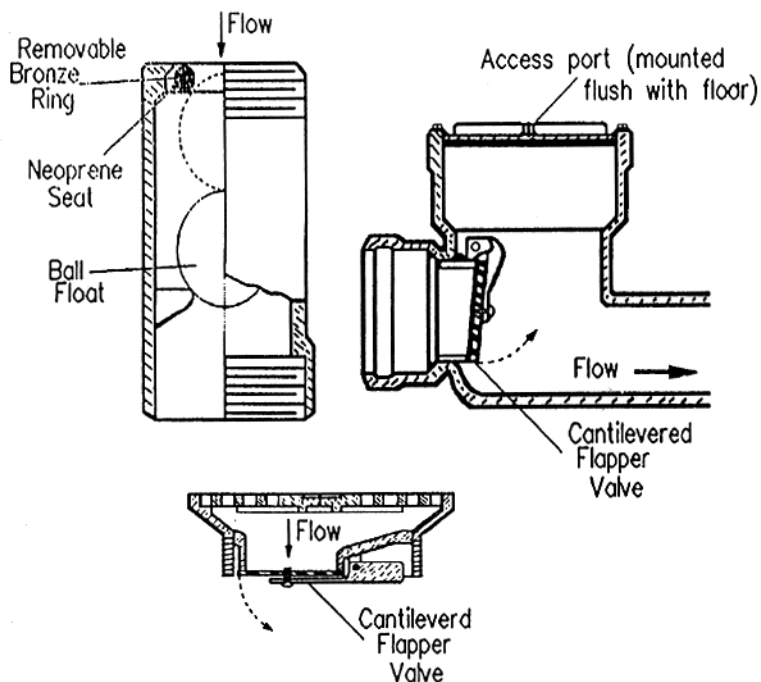
Utility service lines and pipes shall not be unnecessarily exposed on walls or ceilings in walk-in refrigeration units, food preparation areas, equipment washing areas, utensil washing areas, toilet rooms, and vestibules. Exposed utility service lines and pipes shall be installed in a way that does not obstruct or prevent cleaning of the floor, walls, and ceiling. Installation of exposed horizontal utility lines and pipes on the floor is prohibited.



## Chapter VII - Installation of Walk-in Coolers/Freezers

Walk-in coolers and freezers shall be sealed to walls and floors. When the distance between the top of the cooler/freezer and the ceiling is 24 inches or less, an approved enclosure shall be required. Floor drains may be installed on the interior of walk-in coolers, provided they are equipped with backwater valves. These backwater valves shall be accessible for inspection and maintenance.

(Figure 10 illustrates several backwater valves)



**Figure 10**

## **Drainage**

Walk-in coolers used for iced storage of fish and chicken shall be equipped with an approved means of containment for drainage. This may be accomplished as follows:

1. A recessed floor area graded to a floor drain equipped with a backwater valve.
2. A mobile drainage cart.
3. A portable catch basin.

The condensate drain line should be trapped and shall be indirectly drained into a properly trapped floor drain or hub drain, into an exterior dry well, or by some other disposal method which does not create a nuisance.

### *Note:*

A catch pan which requires periodic dumping is not acceptable for containing condensate drainage.

## **Shelving**

Shelves and racks shall be properly constructed of safe materials, corrosion resistant, nonabsorbent, smooth, easily cleanable, durable under normal use conditions, and provide a minimum clearance of six inches above the floor. It is recommended that shelves and racks be constructed of aluminum, stainless steel, plastic, or epoxy/vinyl coated metal. Wooden shelves and racks shall be properly sealed.

### *Note:*

Pallets, bread racks, milk crates, etc. are not acceptable for use as permanent storage racks or shelves.

## **Lighting**

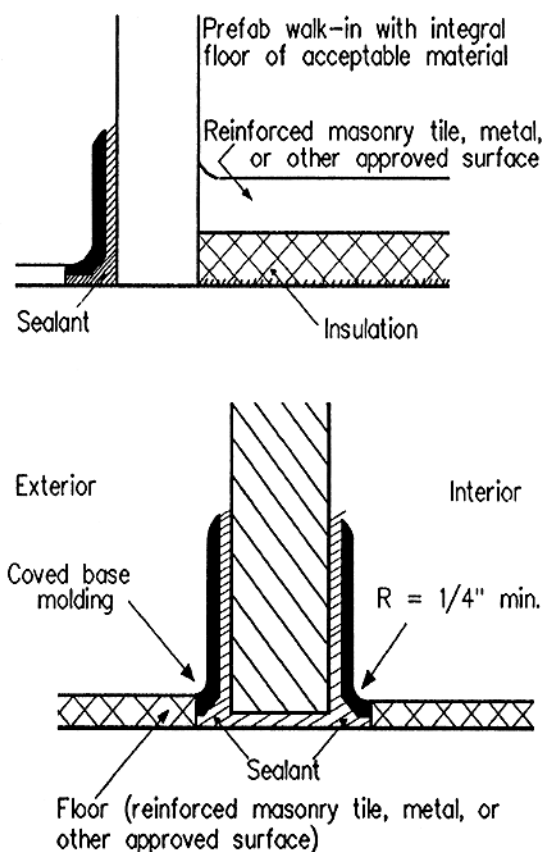
A minimum of 10 foot-candles of light measured at 30 inches above the floor is required in all areas of walk-in coolers/freezers. When food preparation is conducted in a walk-in unit, such as grinding meats or preparing salads, a minimum of 20 foot-candles of light

is required on working surfaces. Walk-in coolers/freezers are typically furnished with one light fixture; consequently, additional light fixtures are usually required to illuminate all areas of walk-in coolers/freezers.

### **Water-flush Cleaning**

Walk-in units subject to water flushing shall have junctures between floors and walls coved and sealed, and floors shall be graded to drain.

(Figure 11 illustrates this installation)



**Figure 11**

## **Chapter VIII - Counter Protector Devices (Sneeze Guards)**

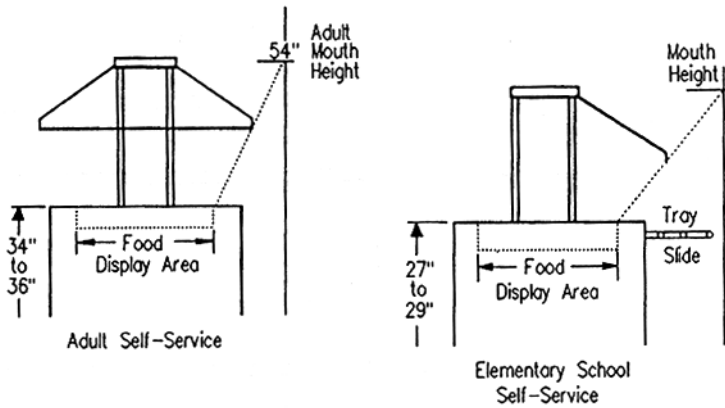
Food on display shall be protected from contamination by packaging, approved sneeze guards, or by other effective means. Unwrapped food displayed on serving lines, buffet tables, salad bars, or other equipment shall be effectively shielded. This protection shall intercept the direct line between the average adult mouth height and the food being displayed. The vertical distance from the floor to the average mouth height of an adult customer, including middle school and high school students, is considered to be 54 inches to 60 inches. The counter height of food displays should be 34 to 36 inches above the floor for adult self-service. Soup and similar food may be dispensed by the customer from covered containers when approved by the health authority.

Elementary schools which elect to offer self-service to children in kindergarten through fifth grade will require lower counter heights for sneeze guards to be effective. A counter height of 27 inches to 29 inches is needed in lieu of the 34 to 36 inch height for adult counter tops.

(Figure 12 illustrates mouth and counter height requirements)

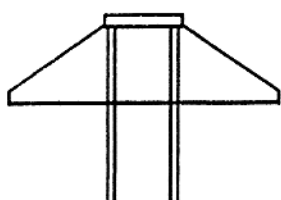
When tray slides are provided on self-service equipment, the effectiveness of sneeze guards will be diminished and adjustments will be required. It is recommended that sneeze guards be adjustable for height and angle alignments.

**Figure 12**

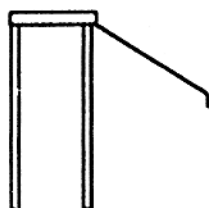
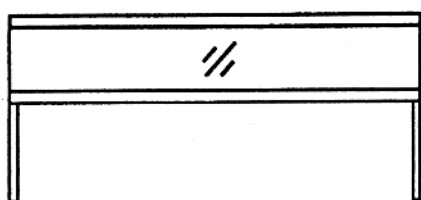


Buffet style food displays shall have food containers located to accommodate the reach of persons normally utilizing the food display. To prevent contamination, food should not be displayed at more than 30 inches from the serving side of the counter.

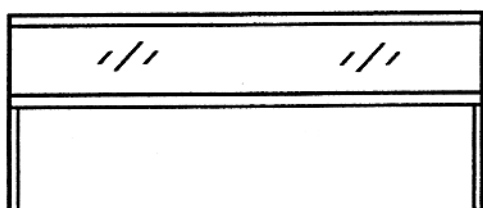
(Figure 13 illustrates various sneeze guard installations)



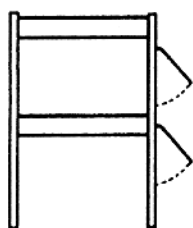
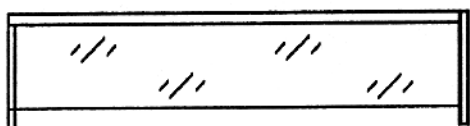
Double Buffet Service



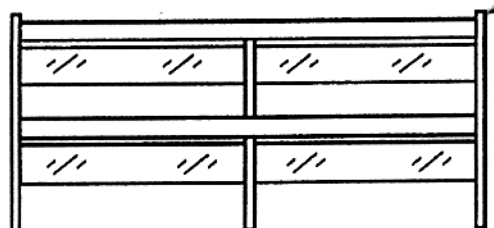
Single Buffet Service



Cafeteria Service



Double Tier Cafeteria Service



**Figure 13**

## **Other Concerns With Food Display Equipment**

When self-service food displays are located in dining areas, the floors under and around the display equipment (within three feet) should be constructed with a smooth, durable, and easily cleanable material. Vinyl runners and rubber mats may also be used over carpet to contain spillage and facilitate cleaning. Regardless of the floor material, floors under and around display equipment shall be kept clean and in good repair.

Permanently installed food display equipment having drainage from condensers, ice pans, or hot food wells shall be indirectly drained to the building sewer system. Equipment with water connections shall be provided with back-siphonage protection (an air gap or an approved backflow prevention device). Food equipment should be used according to the manufacturer's specifications. Example: hot holding equipment, which is designed to maintain hot food at a safe temperature, shall not be used for the heating or reheating of food. This process requires equipment designed to rapidly heat or reheat food.

## **Chapter IX - Hot Water Sizing Requirements**

A hot water system is sized according to the fixtures supplied with hot water and the potential use of these fixtures operating simultaneously during periods of peak demand. It is generally accepted that peak hot water consumption occurs during an average two hour cleaning period for most retail food establishments.

The following hot water consumption requirements, which have been extracted from tables and recommendations by the National Sanitation Foundation (NSF), Food and Drug Administration (FDA), American Gas Association (AGA), and water heater manufacturers, have proven effective for meeting the hot water needs of the retail food industry.

Hot water systems shall be sized to meet the peak hot water demand for all fixtures in accordance with the following table:



Item	Gallons Per Hour Each	Total
Vegetable sink .....	10	_____
1-compartment utensil sink.....	20	_____
3-compartment utensil sink (paper service) .....	60	_____
3-compartment utensil sink (full service).....	90	_____
Prerinse sink.....	45	_____
3-compartment bar sink .....	30	_____
**Lavatory (hand sink).....	05	_____
Mop sink (can wash).....	20	_____
Warewasher (____gals/hr. final rinse x 70%).....		_____
TOTAL DEMAND = _____		
** Shall be at least 110°F. (37.8°C.)		

The hot water system is sized to meet the total hot water demand for all fixtures at a temperature of 140°F. (60°C.). The adequacy of the system to meet sizing requirements shall be determined by adding the storage capacity of the heater to the heater's recovery capacity per hour at a 100°F. (37.8°C.) rise to yield the total gallons of the system. For handwashing purposes, hot water supply lines to lavatories may be equipped with mixing valves to temper the hot water supplied to these fixtures. Handwashing lavatories shall be supplied with hot water at a temperature of at least 110°F. (37.8°C.). The recovery rate of water heaters is based on a 100°F. (37.8°C.) rise due to the low potable water temperatures recorded across the state during cold weather months.

## **Gas and Electric Hot Water Recovery Rates**

1,000 BTU input will heat 0.84 gallons of water at a 100°F. rise.

1,000 Watts (1kW) will heat 4.1 gallons of water at a 100°F. rise.

With reclaim systems, only the storage capacity of the tank, plus the recovery capacity of any heating elements, can be used in sizing the hot water system. Normally, reclaim systems are used in conjunction with conventional water heaters.

It is strongly recommended that schools, prisons, hotels, and other large facilities provide a separate hot water system for food service operations, rather than installing one general hot water system to supply all hot water demands. An individual hot water system can ensure a calculated and consistent supply of hot water to the food service operation without the fluctuating demands created by showers, baths, laundries, and other fixtures which may adversely affect the kitchen supply. However, facilities that plan a single hot water system shall furnish a system accurately sized to meet total fixture demand.

## **Instantaneous Water Heaters**

Instantaneous water heaters are designed primarily for limited use, but may be approved provided they meet the total hot water demand of the fixtures served. In commercial usage, most instantaneous water heaters are limited to point-of-use applications due to their design limitations. These water heaters lack hot water storage and have restricted flow rates; consequently, few are capable of supplying an adequate flow of water to multiple fixtures.

## **Heat Reclaim Systems**

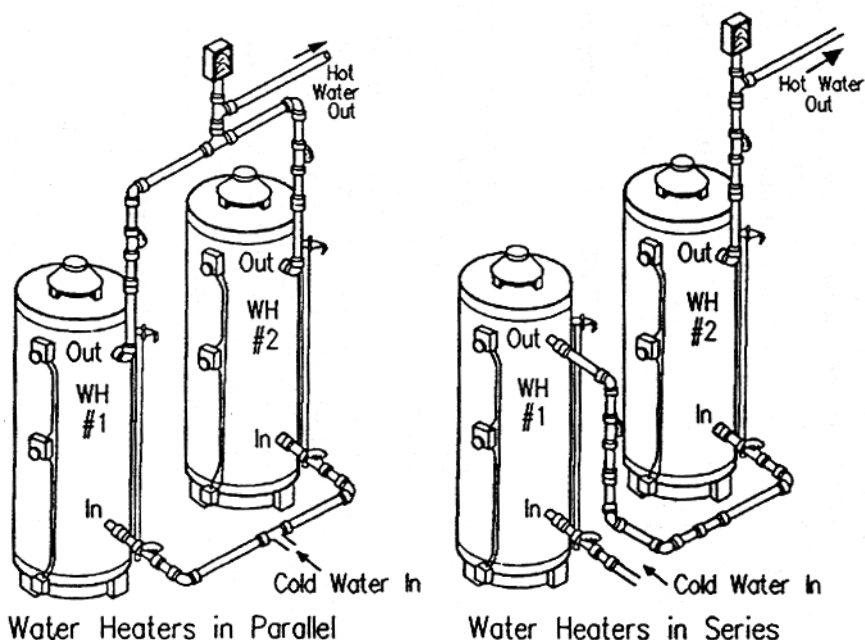
Heat reclaim systems recover heat energy from refrigeration equipment within the establishment and use this energy to generate hot water. A heat reclaim system includes a storage tank and may be used to preheat the water entering a water heater. While a reclaim unit will increase the water heater's recovery capacity,

its capability to generate hot water varies with energy input. Consequently, only the storage capacity of the tank plus any recovery capacity can be used in calculating hot water.

### **Multiple Water Heaters**

Water heaters which have small storage tanks, but possess large recovery capabilities may appear adequate to meet total fixture demand. However, in some cases these heaters have not been able to deliver enough hot water for immediate use. When two or more water heaters are used to provide a single source, they should be plumbed in parallel to provide maximum hot water output. When water heaters are plumbed in series, only the first heater's recovery capacity may be added to the system's total storage capacity for sizing purposes.

(Figure 14 illustrates parallel and series installations.)



**Figure 14**

## **Chapter X - Manual Washing, Rinsing, and Sanitizing of Utensils and Equipment**

The cleaning and bactericidal treatment of food service utensils and equipment must be carried out systematically. Poorly washed and sanitized utensils and equipment may be responsible for the transmission of various bacterial and viral diseases, such as influenza, tuberculosis, diphtheria, pneumonia, whooping cough, and the common cold. Bacteria that cause foodborne illnesses such as salmonellosis, shigellosis, listeriosis, and staphylococcus intoxication can also be transmitted by improperly cleaned and sanitized utensils and equipment.

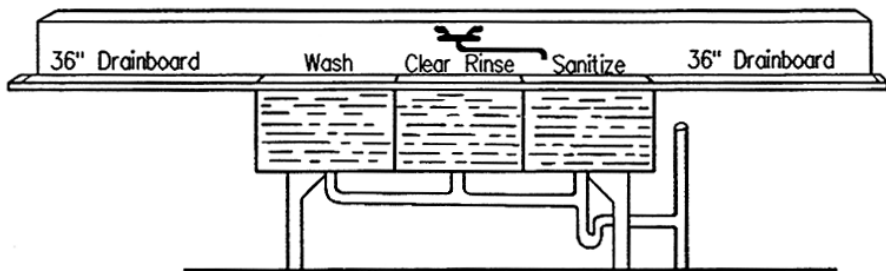
Sink compartments shall be large enough to immerse at least two-thirds of the largest utensil to be cleaned. Sinks and drainboards shall be self-draining. Drainboards should be sized to accommodate the largest number of utensils to be processed through the sink at any given time. It is essential to provide adequate air-drying space to avoid wet storage or towel drying of utensils. Overshelves or mobile dish carts may be used in addition to drainboards.

(Figure 15 illustrates 3-compartment sink installations.)

Equipment and utensils shall be preflushed, prescraped, or presoaked as necessary to remove gross food particles and soil.

### **Wash**

Equipment and utensils shall be thoroughly washed in the first compartment with a hot detergent solution that is kept clean.



Recommended dishwashing arrangement using three-compartment sink. Counters for soiled dishes and for cleaned utensils must be adequate.

**Figure 15**

### **Rinse**

Equipment and utensils shall be rinsed free of detergents and abrasives with clean water in the second compartment.

### **Sanitize**

Equipment and utensils shall be sanitized in the third compartment by:

1. use of an approved chemical sanitizer; or
2. use of 170°F. (76.7°C.) hot water.

Hot water sanitizing requires a sink heater, thermometer, and dish baskets.

## **Chapter XI - Warewashing Machine Installation**

(Figure 16 illustrates a warewashing machine installation.)

1. A warewashing machine shall meet the approval of the National Sanitation Foundation (NSF) or shall otherwise comply with the requirements of Regulation 61-25, Retail Food Establishments for mechanical warewashing.
2. All warewashing machines shall have either a built-in prewash section or a manual prerinse sink; except that, under certain use conditions, small warewashers and glass washers which do not involve the removal of gross food particles are exempt from prerinse requirements.
3. Detergents and sanitizers shall be automatically dispensed, and dispensers shall be properly installed and maintained. Drying agents shall be injected downstream of the final rinse vacuum breaker.
4. All warewashing machines shall be indirectly drained.

(Figure 17 illustrates acceptable indirect drains.)

5. A backflow prevention device or air gap is required to prevent back-siphonage of contaminated water into the potable water supply.

## Recommended Warewashing Machine Installation

Point of installation for detergent dispenser and drying agent dispenser.

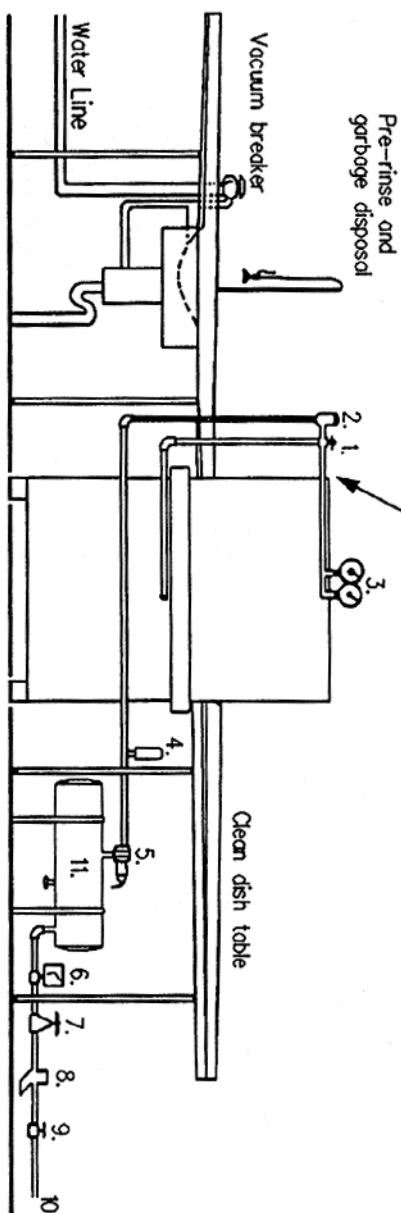
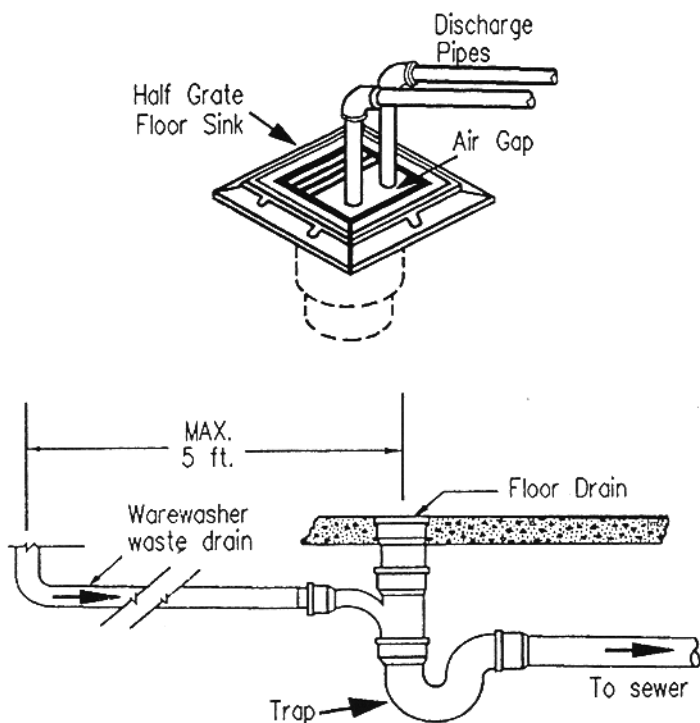


Figure 16

**Note:** An approved self-regulating heat tape or a recirculating pump is required if the distance from the water heater to the booster heater is more than 25 pipe feet.



**Figure 17**

6. Thermometers are required for the wash tank and the final rinse water line to ensure proper temperature.
7. Flow pressure of the final rinse water shall be maintained at 15-25 psi. On most warewashing machines, this is controlled by a pressure reducing valve that is designed to regulate water pressure at 15-25 psi, followed by a pressure gauge to monitor the final rinse pressure.

*Exception:*

“Fill and dump” warewashing machines have a pumped rinse regulated by a pump preset to operate at 15-25 psi; the pressure



regulating valve and pressure gauge are not required on these machines.

8. A shock arrestor is recommended to absorb the natural vibrations caused by the opening and closing of the solenoid valve. This device prevents leaking pipe joints and noises created by these vibrations.
9. All warewashing machines shall be operated in accordance with temperature requirements specified in Regulation 61-25, Retail Food Establishments.

### **Hot Water Sanitizing**

Hot water sanitizing in most warewashers requires a 180°F. (82°C.) to 195°F. (91°C.) hot water temperature. This is provided by a booster heater on the 140°F. (60°C.) water supply line, or by a 180°F. (82°C.) water supply line directly from the primary water heater. In the latter option, a thermostatic mixing valve should be installed to temper the hot water supplied to other fixtures.

1. Provisions shall be made to ensure that 140°F. (60°C.) hot water is delivered to the booster heater when the length of the water line from the primary water heater to the booster heater exceeds 25 pipe feet. Lines exceeding 25 pipe feet shall be recirculated, wrapped with an approved self-regulating heat tape, or be capable of maintaining the required water temperature by other methods approved by the health authority. Booster heaters are normally sized to raise the final rinse temperature 40°F. (4.4°C.). A recirculated hot water system includes a circulating pump, a hot water supply line, and a return line. Together, they provide circulated hot water from the primary water heater to the booster heater and back to the water heater. The booster heater can then raise the 140°F. (60°C.) water 40 degrees to the required 180°F. (82°C.) minimum final rinse temperature. This eliminates cooling of the 140°F. (60°C.) water held in the pipe between warewashing cycles.

An approved self-regulating heat tape will also maintain a 140°F. (60°C.) water temperature the entire length of the taped water line.

2. The booster heater shall be either built-in or be installed within five feet of the warewashing machine. If installed more than five feet from the warewashing machine, the 180°F. (82°C.) final rinse supply line from the booster heater to the warewasher shall be either recirculated or equipped with an approved self-regulating heat tape.
3. The typical minimum hot water sanitizing temperature is 180°F. (82°C.) and the maximum is 195°F. (91°C.). When the temperature of the final rinse exceeds 195°F. (91°C.), atomization occurs, which results in an ineffective spray pattern and inadequate sanitization.

### **Chemical Sanitizing**

1. Chemicals added for sanitization purposes shall be automatically dispensed.
2. Utensils and equipment shall be exposed to the final chemical sanitizing rinse in accordance with manufacturers' specifications for time and concentration.
3. The chemical sanitizing rinse water temperature shall be no less than 75°F. (24°C) or less than the temperature specified by the machine's manufacturer.
4. Chemical sanitizers shall be approved by the health authority.
5. A test kit or device that accurately measures the parts per million (ppm) concentration of the solution shall be accessible and used.

## **Chapter XII - Storage of Food, Equipment, Utensils, and Single-service and Single-use Articles**

Food, equipment, utensils, and single-service and single-use articles shall be stored in a manner which protects them from contamination. Storage facilities shall comply with the following:

1. Except where specifically allowed by regulation, containers of food, and clean equipment and utensils shall be stored on shelving at least six inches above the floor, unless they are stored on dollies or in closed cabinets. Pots, pans, and other utensils may be stored on hooks or racks.
2. Storage racks, shelves, cabinets, and other facilities shall be constructed of materials which are smooth, nonabsorbent, and easily cleanable. Storage shelves, racks, and cabinets constructed of wood shall be sealed or painted to render a nonabsorbent and easily cleanable surface.
3. Pallets are not acceptable for permanent storage and shall be removed when emptied of delivered contents.
4. Acceptable storage methods for in-use dispensing utensils are:
  - a. Stored in dipperwells installed with running water, back-siphonage protection, and indirect drainage.
  - b. Stored in the food with the handle extended out of the food.
  - c. Stored clean and dry.
  - d. When “a” through “c” are impractical, self-service utensils, such as tongs, may be stored in a clean, protected location approved by the health authority.

5. Food, equipment, utensils, and single-service and single-use articles shall not be stored under exposed sewer lines or in toilet rooms.
6. Outside storage facilities used for the storage of food and single-service and single-use articles should be limited to unopened cases.
7. Adequate storage space shall be provided for proper storage of food supplies and single-service and single-use articles, both routinely as well as during periods of delivery.

*Note:*

Lawn mowers, weed trimmers, blowers, gasoline containers, pesticides, motor oils, and other materials used to maintain the exterior of the establishment, and which are stored on the premises, shall be stored in a manner which precludes contamination of food, equipment, utensils, and single-service and single-use articles.

## **Chapter XIII - Ventilation**

Regulation 61-25, Retail Food Establishments requires that all rooms of a permitted retail food establishment be adequately ventilated and kept reasonably free of grease, excessive heat, steam, condensation, vapors, smoke, and fumes. Mechanically introduced make-up air shall be provided as necessary.

The following information is provided to offer guidance in meeting the requirement for ventilating cooking equipment. There are several methods used in calculating the volume of air movement, measured in Cubic Feet per Minute (CFM), necessary to effectively and efficiently ventilate cooking equipment. While these methods are used in general applications, it must be noted that engineered exhaust systems which are customized for specific equipment under specific use conditions may also be approved by the health authority.

### **General Principles of Exhaust**

The purpose of an exhaust hood is to provide a method of collecting, as nearly as possible, all of the grease produced from the cooking process, while furnishing a means of removing heat, smoke, and odors from the cooking area.

For the hood to fulfill its purpose, there must be a sufficient volume of air movement (capture velocity) to draw grease particles and cooking vapors directly from the cooking surface to the grease extractors. This air flow removes cooking odors and keeps grease particles from settling onto nearby surfaces.

An effective capture velocity shall be sufficient to overcome opposing air currents, capture the grease and cooking vapors, and transport them directly to the grease extractors.

Grease extractors are ineffective in removing grease vapors. Only when grease vapors cool and condense can an extractor remove grease particles by directed air flow, contraction, and expansion

(drop out). It is essential to have a sufficient volume of air flowing to cool and condense the grease vapors into grease particles prior to reaching the grease extractors.

Non-toxic smoke bombs may be used to evaluate and regulate kitchen exhaust hoods and supply systems. No fabricator of exhaust hoods can create all the conditions in the plant that the hood must cope with on the job site to function correctly.

In the case of heat and steam producing equipment, the purpose of a canopy hood or ventilation system (such as a pants-leg duct system) is to control humidity, heat, and unwanted condensation. These canopy hoods shall be equipped with a removable mesh filter over the duct opening.

A major cause of unacceptable hood performance is a lack of coordination between the Heating, Ventilation, and Air Conditioning (HVAC) system and the exhaust hood system. These systems should be coordinated prior to installation, and balanced when installation is completed, to ensure the proper performance of both.

## **Fire Protection**

Exhaust ventilation systems for all grease producing cooking equipment is also under the jurisdiction of the State Fire Marshal's Office and local fire and building officials. System designers and/or owners should contact these officials regarding fire safety plan review and inspection.

## **Hood Size**

1. Canopy hoods and island hoods shall have a minimum depth of two feet and shall extend at least six inches beyond any equipment being ventilated, except that no overhang will be required on sides where aprons are installed. The dimensions of the hood are, in all cases, larger than the cooking surface to be covered by the hood. The amount of overhang of the hood depends upon the clearance or distance between the base of the

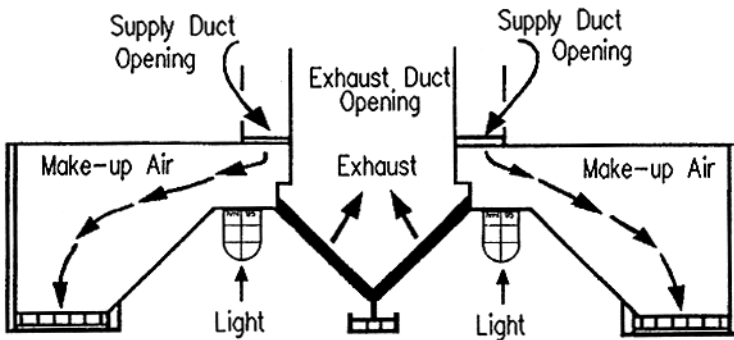
hood and the top of the cooking equipment. A rule of thumb for the overhang on canopy hoods is 0.4 of the distance from the cooking surface to the bottom of the hood, but in any case, no less than six inches.

*Example:*

Hood overhang = distance from bottom of hood to top of range  
=  $0.4 \times 3.25 \text{ ft.} = 1.30 \text{ ft.}$ , or approximately 1 foot, 4 inches

Canopy hoods shall be installed so that the bottom of the hood is between 6.5 feet and 7 feet above the finished floor.

(Figure 18 illustrates a canopy hood.)



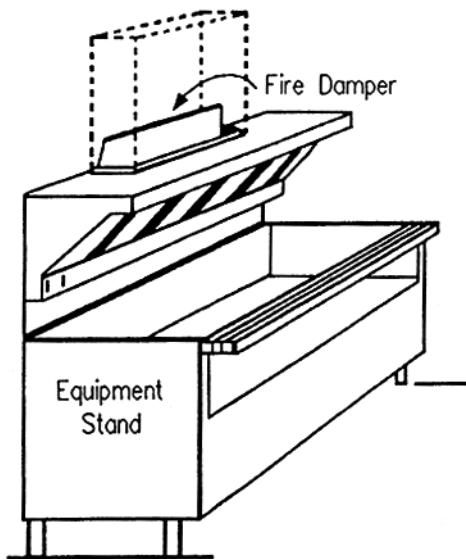
**Figure 18**

2. Ventilator or "backshelf" hoods are designed to mount to the wall directly behind the cooking equipment. This type of hood is often used where ceiling height is a factor. It is normally placed closer to the cooking surfaces than a canopy hood, and works well in light to medium duty cooking applications. The ventilator hood is not recommended for charbroilers or similar high heat and grease producing cooking equipment. It does not have the capture area of a canopy hood and is not able to

effectively handle large surges of cooking emissions (steam, heat, vapors, etc.)

Several dimensions are essential in the proper installation of a ventilator hood. Ventilator hoods shall extend from the wall a minimum of 16 inches, and shall be installed so that the distance from the top of the cooking equipment to the bottom of the ventilator hood is no more than 24 inches. Equipment placed under a ventilator hood shall not extend beyond the sides of the hood or more than 36 inches from the back of the hood. These restrictions are necessary to ensure maximum capture and removal of cooking emissions.

(Figure 19 illustrates a ventilator hood.)

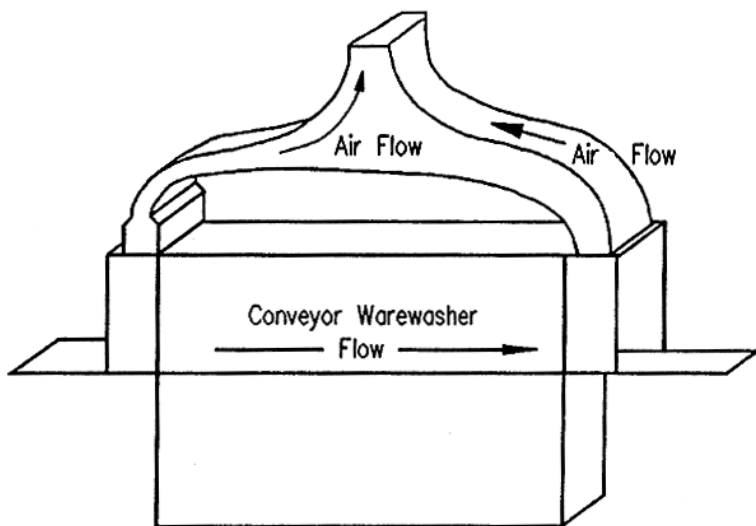


**Figure 19**



3. Pants-leg exhaust systems are designed to remove the heat or steam close to the point of discharge from warewashers or conveyor cooking equipment. These systems must be sized to effectively ventilate the equipment served.

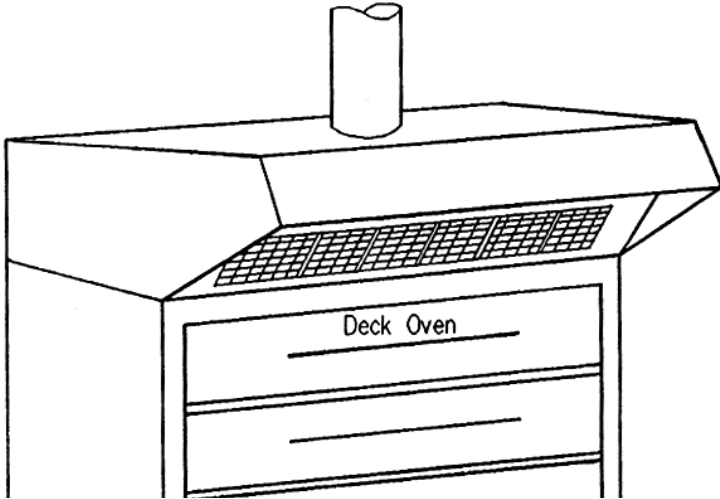
(Figure 20 illustrates a pants-leg duct system.)



**Figure 20**

4. Eyebrow hoods are designed to immediately remove heat from an oven at the point of emission or as the door is opened. These hoods must effectively ventilate the door openings of the equipment served.

(Figure 21 illustrates an eyebrow hood.)



**Figure 21**

### **Exhausted Air**

The amount of air exhausted through a hood exhaust system is dependent upon the size of the hood, its particular installation, and its use. There are several methods available for determining the amount of air to be exhausted. With the exception of systems engineered for specific equipment and specific applications that are approved by the health authority, the following criteria shall be used to calculate the amount of air exhausted:

1. Canopy hoods.
  - a. Standard square foot method.

This method of calculating exhaust air volume is based on the size of the opening in the hood (length x width) and the capture velocity relative to the installation of the hood (see Table I).

Hood length x hood width = square feet (ft.<sup>2</sup>) of hood opening.

Ft.<sup>2</sup> of hood opening x factor from Table I = CFM of air exhausted.

Table I	
Exposed sides	Factor(CFM/ft. <sup>2</sup> )
4 (central island hood)	125
3 (wall hung hood)	100
2 (corner hung hood, or with aprons)	85
Steam or heat exhaust only	70

*Example:*

8 ft. (length) x 4 ft. (width) = 32 ft.<sup>2</sup>

32 ft.<sup>2</sup> x 100 CFM/ft.<sup>2</sup> (wall hung hood) = 3200 CFM

b. Exposed linear foot method.

This method of calculating the exhaust air volume is based on the total exposed linear footage of the hood and the capture velocity relative to its application (See Table II).

Exposed linear footage of hood x factor from Table II =  
CFM of air exhausted.

**Table II.**

<b>Application</b>	<b>Factor (CFM/lin. ft.)</b>
Light duty (no grease, light grease)	150 - 250
Medium duty (fryers and griddles)	250 - 350
Heavy duty (heavy grease, charbroiler)	350+

*Example:*

4 ft. x 8 ft. hood (light grease), 3 exposed sides

4 ft. + 8 ft. + 4 ft. = 16 exposed linear ft.

16 exposed linear ft. x 250 CFM/linear ft. = 4000 CFM

c. Square feet of cooking surface method.

This calculation of the volume of exhausted air depends on the size, temperature, and design of the cooking equipment and the minimal capture velocity required to keep smoke, vapors, and fumes under the hood. The amount of air to be removed is calculated by multiplying the surface area of the equipment (ft.<sup>2</sup>) by the appropriate updraft velocity factor (see Table III); total air exhausted is the sum of exhaust air volumes of all the equipment added to the minimal capture velocity.

Ft.<sup>2</sup> of cooking surface of each piece of equipment (length x width) x the updraft velocity factor from Table III = CFM of exhaust required for each piece of equipment.

**Table III.**

<b>Application</b>	<b>Updraft velocity factor</b>
Steam kettles, ranges, ovens, non-grease producing equipment	50 fpm
Fryers/griddles, grease producing equipment	85 fpm
Charbroilers, high heat and grease producing equipment	150 fpm

*Example:*

<u>Equipment</u>	<u>Square feet</u>
oven	30" x 36" = 7.5 ft. <sup>2</sup>
fryer	18" x 24" = 3.0 ft. <sup>2</sup>
charbroiler	32" x 54" = 7.6 ft. <sup>2</sup>
range	42" x 34" = 9.6 ft. <sup>2</sup>

<u>Ft.<sup>2</sup></u>		<u>Factor</u>	<u>Exhaust</u>
7.5	x	50 fpm	375 CFM
3.0	x	85 fpm	255 CFM
7.6	x	150 fpm	1140 CFM
9.6	x	85 fpm	<u>816 CFM</u>
Total equipment exhaust volume		=	2586 CFM

The minimal capture velocity = [hood opening area (ft.<sup>2</sup>) - cooking equipment surface area (ft.<sup>2</sup>)] x 50fpm

*Example:*

4 ft. x 15 ft. hood = 4 ft. x 15 ft. = 60 ft.<sup>2</sup> hood opening

Cooking equipment surface area (from above) = 7.5 ft.<sup>2</sup> + 3 ft.<sup>2</sup>  
+ 7.6 ft.<sup>2</sup> + 9.9 ft.<sup>2</sup> = 28 ft.<sup>2</sup>

Minimal capture velocity = [60 ft.<sup>2</sup> - 28 ft.<sup>2</sup>] x 50 fpm = 32 ft.<sup>2</sup> x  
50 fpm = 1600 CFM

Total system exhaust volume = equipment exhaust volume +  
minimal capture velocity

*Example:*

Total system exhaust volume = 2586 CFM (from above) + 1600  
CFM (from above) = 4186 CFM

## 2. Ventilator and backshelf hoods.

Linear footage of hood x ventilator exhaust factor from Table IV  
= CFM of air exhausted.

**Table IV.**

<b>Application</b>	<b>Exhaust Factor</b>
Light duty (non-grease producing)	200 CFM/ft.
Medium duty (light grease producing)	275 CFM/ft.
Heavy duty (heavy grease producing)	350 CFM/ft.

*Example:*

12 ft. ventilator hood, medium duty (light grease producing)

12 ft. x 275 CFM/ft. = 3300 CFM air exhausted

### **Duct Location and Size**

Exhaust ducts should never be located at the sides of the hood. For hoods that are six feet or less in length, only one outlet should be provided. Long hoods should be provided with multiple outlets no closer than six feet apart and no further than 12 feet apart. For hoods equipped with multiple ducts, it is advisable to install a manual air volume damper on each outlet so that the system can be easily balanced.

A duct velocity of no less than 1500 fpm shall be provided to maintain suitable conditions in the duct work. In some cases, a greater duct velocity (i.e. 1800-2200 fpm) may be necessary for the system to function at its best. The cross-sectional area of the exhaust duct (in ft.<sup>2</sup>) can be calculated by using the following formula:

Duct area required (ft.<sup>2</sup>) = Volume of air exhausted (CFM) ÷ Duct velocity (fpm)

*Example:*

Duct area required (ft.<sup>2</sup>) = 3000 CFM ÷ 1500 fpm = 2 ft.<sup>2</sup>

The area of round duct can be determined from Table V.

**Table V.****Sizing Chart for Round Duct**

<b>Duct Diameter</b>	<b>(In.<sup>2</sup>)</b>	<b>Duct Area (Ft.<sup>2</sup>)</b>
10 inches	78.54	.545
12 inches	113.1	.785
13 inches	132.7	.922
14 inches	153.9	1.069
15 inches	176.7	1.227
16 inches	201.0	1.396
18 inches	254.4	1.767
19 inches	283.5	1.969
20 inches	314.1	2.182
21 inches	346.3	2.405
22 inches	380.1	2.640
24 inches	452.3	3.142

Once removed, the grease is drained into a collection container in the hood or elsewhere. Extractors have generally replaced wire mesh filters where grease removal is of prime concern and compliance with National Fire Protection Association (NFPA) codes is required. Wire mesh filters may be used to exhaust pizza ovens, bread and pastry ovens, and other similar equipment where grease is not of prime concern. Both wire mesh and extractor type filters have an efficient operating velocity range of 200 to 500 fpm; the operating velocity of the filters shall not be less than 200 fpm.



## **Grease Filter Area and Number of Grease Filters Required**

There are two general types of grease filters: wire mesh and extractor filters. The extractor filter removes grease in the exhaust process by centrifugal motion or by impingement on a series of baffles.

The manufacturer's optimum rating of the filter should be used in calculating the filter area required in the exhaust system. Standard size filters should be used to avoid additional cost and to allow ease of replacement. Any space in the filter bank not covered by filters/extractors shall be fitted with sheet metal blanks. If calculations indicate that a fraction of a filter is needed, add an additional filter. The filter area required for an exhaust system can be calculated by using the following formula:

Filter area needed (ft.<sup>2</sup>) = Volume of air exhausted (CFM) )  
Operating velocity of the filters (fpm)

*Example:*

Filter area needed (ft.<sup>2</sup>) = 3200 CFM ) 500 fpm = 6.4 ft.<sup>2</sup>

Filters are sized and made removable so that they may be passed through a warewashing machine or cleaned under a steam jet.

Standard size grease filters are:

12 inches x 16 inches

16 inches x 20 inches

16 inches x 25 inches

20 inches x 20 inches

20 inches x 25 inches

The following example illustrates how to determine the number and size of filters needed.

*Example:*

$$1 \text{ ft.}^2 = 144 \text{ in.}^2; \text{ a } 16 \text{ in.} \times 20 \text{ in. filter} = 320 \text{ in.}^2$$

$$320 \text{ in.}^2 \div 144 \text{ in.}^2 = 2.22 \text{ ft.}^2$$

3 filters of 16 in. x 20 in. = 6.66 ft.<sup>2</sup>; therefore, 3 filters of 16 in. x 20 in. will meet the filter area requirement of 6.4 ft.<sup>2</sup> calculated in the previous example.

## **Calculating Static Pressure**

To select the proper size fan, the volume of air to be moved and the total resistance to its movement must be known. There are a number of restrictions in an exhaust system which affect air flow. The resistance to air movement is measured in inches of water, and this friction loss is called static pressure (S.P.).

The static pressure against which the exhaust fan must work is considered to be the sum of the following five items:

1. the resistance of the grease filters measured under heavy use. A value of .2 inches of water is ample for most filters.
2. the “entrance loss” of static pressure occurring where the exhaust duct attaches to the hood will be about .1 inch of water.
3. the resistance created by natural winds blowing on the exhaust duct opening is a matter of judgement; the average wind pressure is approximately .15 inches of water.
4. the energy, or accelerating pressure, required to accelerate the air to the duct velocity, usually about .20 inches of water.
5. the resistance of the exhaust ducting, which is determined by the total length of the straight duct plus the number and type of elbows.

The values used to determine the static pressure that a fan must overcome are specified in Table VI.

**Table VI**

<b>Type of resistance</b>		<b>Amount of resistance</b>
filter		.20 inches
hood entrance loss		.10 inches
wind pressure		.15 inches
accelerating pressure		20 inches
duct resistance		
straight duct		.0025 inches per linear ft.
angles -	90 <sup>0</sup>	.20 inches each
	45 <sup>0</sup>	.10 inches each
	30 <sup>0</sup>	.05 inches each

*Example:*

An exhaust hood with a straight duct of 8 feet with two 45<sup>0</sup> elbows.

### Static Pressure

<b>Item</b>		<b>Total</b>
Duct (8 ft. x .0025)	=	.02 inches
Elbows (2 x .10)	=	.20 inches
Filter resistance	=	.20 inches
Hood entrance loss	=	.10 inches
Wind pressure	=	.15 inches
Accelerating pressure	=	.20 inches
TOTAL =		.87 inches

## **Fan Size**

The exhaust fan shall be sized to remove the amount of air to be exhausted at the required static pressure.

## **Make-up Air**

The term “make-up air” is used to identify the supply of outdoor air to a room or building to replace the air removed by an exhaust system. For a consistent and regulated flow, make-up air should be mechanically introduced by a fan, swamp cooler, etc. Mechanically introduced make-up air shall be supplied as part of the exhaust system when the amount of air to be exhausted exceeds 1500 CFM.

Make-up air is critical to the design of a ventilation system. It is generally recognized that all systems exhausting more than 1500 CFM need mechanically introduced make-up air to ensure a balanced system. Mechanical engineers recommend that make-up air be supplied at 85 to 90 percent of the exhausted air. Make-up air controls should be interlocked with exhaust controls to ensure that the units operate simultaneously. Replacement air shall be filtered and may also be tempered by a separate control. The air velocity through the make-up air system should be low enough to avoid the possibility of drafts. It is desirable to have the kitchen under a very slight negative pressure to prevent any filtration of cooking odors from the kitchen into the dining room. The supply of make-up air is frequently introduced at some point within the hood, or in close proximity to the hood, to avoid the removal of conditioned air that has been heated or cooled.

The make-up air inlet should be located at least 10 feet from the exhaust fan to comply with NFPA requirements.

Air conditioning may also serve as a source of make-up air, with each ton of an air conditioning system supplying 400 CFM of outside air.

## **Lighting**

A minimum of 20 foot-candles of light is required on all cooking surfaces and work surfaces under the hood. In most cases where canopy hoods are installed, lights within the hood itself are necessary to meet this requirement.

## **Chapter XIV - Pest Control**

### **Pesticides - Automatic Dispensers**

Automatic pyrethrin-dispensing devices may be used in retail food establishments provided they meet the following criteria for installation and operation.

1. The device shall be installed and operated in compliance with the registered label of the Environmental Protection Agency.
2. Only one dispensing unit per 6,000 cubic feet shall be permitted in food preparation areas, dining areas, or other areas where food contamination or exposure of employees and patrons may occur.
3. The device shall not be installed directly over exposed food, food-contact surfaces, or within 12 horizontal feet of exposed food in front of the device.
4. The dispenser shall be suspended a minimum of seven feet from the floor.
5. The insecticidal formulations will not exceed 1% concentration of pyrethrin with a 10% synergist by weight.
6. This device shall be calibrated to dispense a maximum of 100 milligrams of total material every 15 minutes over a 24 hour period.

### **Insect Electrocutors, Low Voltage Fly Traps, and Light Traps**

Insect electrocutors and low voltage fly traps used in retail food establishments shall meet the following criteria for installation and operation.

1. Insect electrocutors.

- a. In food preparation and serving areas, meat preparation and produce preparation areas, utensil and equipment washing areas, and clean utensil and equipment storage areas, devices shall be installed as follows:
  - (1) Only wall-mounted units shall be used.
  - (2) Units must be installed so that the center of the device is not more than three feet above the floor.
  - (3) These devices shall not be installed closer than five feet from exposed food, food-contact surfaces, or clean equipment and utensils.
- b. Devices mounted higher than three feet above the floor, including ceiling hung units, are acceptable in bulk storage rooms, stock rooms, receiving areas, corridors, and refuse areas.
- c. Catch trays of insect electrocutors shall be emptied as often as necessary.

2. Low voltage fly traps and light traps.

Devices used to trap insects by low voltage and/or adherence shall not be installed above exposed food, clean equipment, utensils, and linens, or unwrapped single-service and single-use articles.



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